Exam 2008

1 when a Capacitor is Connected to a dc Soure, The Voltage rises from 20V to 36V in 4 μs with an average charging current of 0.6 A. Determine the value of the Capacitance. Calculat the change in the energy stord in the Capacitor During this period of time.

Solution

$$Q = C.V = I.t$$

$$\therefore \Delta Q = C.\Delta V = I.\Delta t$$

$$\therefore C(36-20) = 0.6 * 4 * 10^{-6}$$

$$C = \frac{0.6 * 4 * 10^{-6}}{16} = 1.5 * 10^{-7} = 0.15$$

$$W = \frac{1}{2} C V^2$$

$$\therefore \Delta W = \frac{1}{2} C V_2^2 - \frac{1}{2} C V_1^2$$

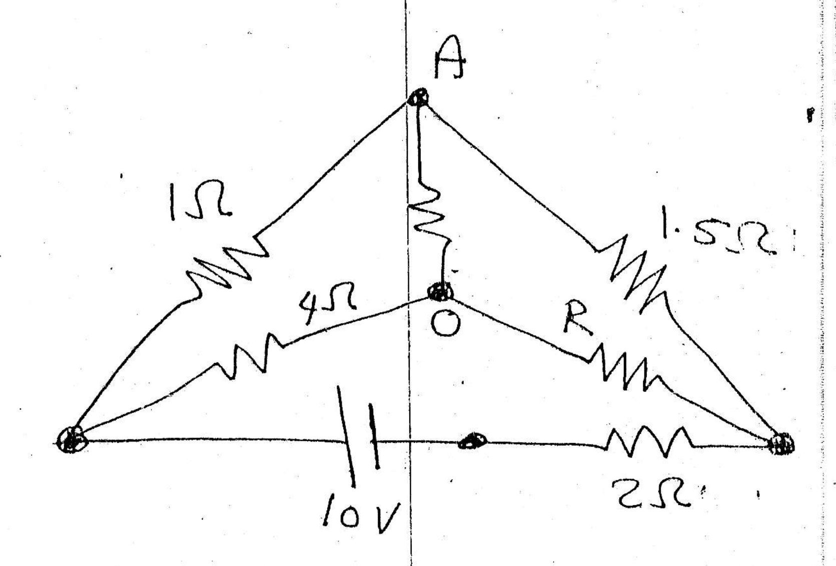
$$= \frac{1}{2} (0.15 * 10^{-6}) [(36)^2 - (20)^2]$$

$$= 6.72 * 10^{-5}$$

$$\simeq 67 \mu J$$

2. For the circuit in fig, Draw the graph of the circuit and two possible trees. what is the number of necessary node and Loop equations? find the power dissipated in the resistance R when the Current in the branch AO:

<u>Solution:</u>

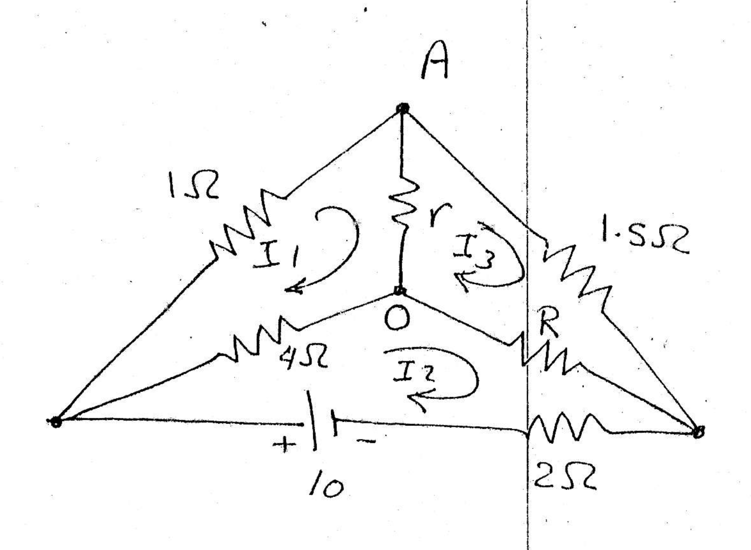


Graph

Tree 1 or tree 2

no. of Nodes = 5 − 2 = 3
(2 → Super node)

no. of Loops = 6 − 3 = 3
(3 → Super loop)



K.V.L for Loop 1

$$0 = I_1 + (I_1 - I_2)4 + (I_1 - I_3)r$$
$$0 = (5+r)I_1 - 4I_2 - rI_3$$

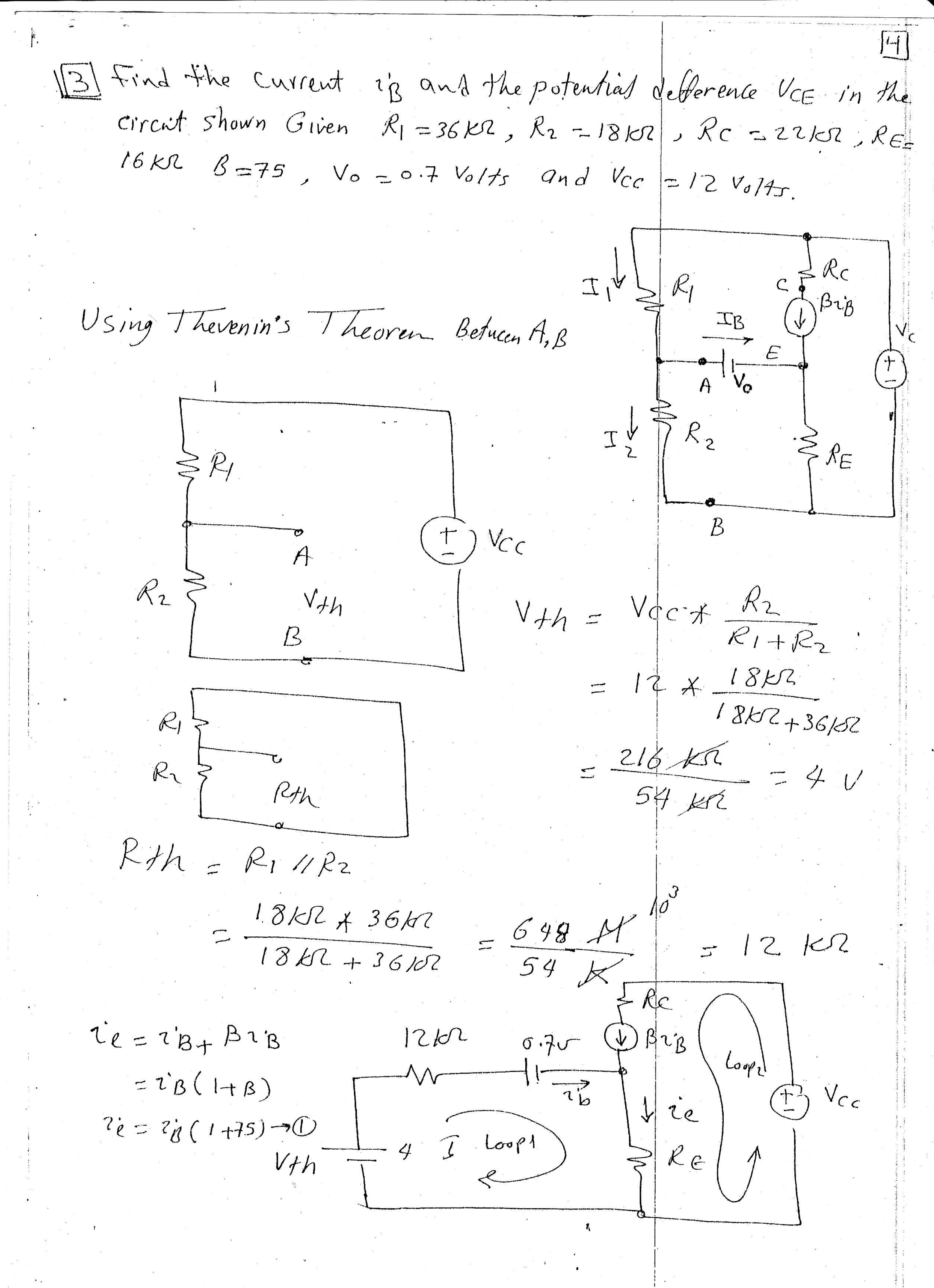
K.V.L for Loop 2

$$10 = (I_2 - I_1)4 + I_2(2) + (I_2 - I_3)R$$
$$10 = -4I_1 + (6+R)I_2 - RI_3$$

K.V.L for Loop 3

$$0 = (I_3 - I_1)r + (I_3 - I_2)R + 1.5\,I_3$$
$$0 = -rI_1 - RI_2 + (1.5+R+r)I_3$$

$$\begin{bmatrix} 0 \\ 10 \\ 0 \end{bmatrix} = \begin{bmatrix} 5+r & -4 & -r \\ -4 & 6+R & -R \\ -r & -R & 1.5+R+r \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$



3 Find the current i_B and the potential defference V_{CE} in the circuit shown Given $R_1 = 36\,k\Omega$, $R_2 = 18\,k\Omega$, $R_C = 22\,k\Omega$, $R_E = 16\,k\Omega$ $\beta = 75$, $V_o = 0.7$ Volts and $V_{CC} = 12$ Volts.

Using Thevenin's Theorem Between A, B

$$V_{th} = V_{CC} * \frac{R_2}{R_1 + R_2}$$

$$= 12 * \frac{18\,k\Omega}{18\,k\Omega + 36\,k\Omega}$$

$$= \frac{216\,k\Omega}{54\,k\Omega} = 4\ V$$

$$R_{th} = R_1 \parallel R_2$$

$$= \frac{18\,k\Omega * 36\,k\Omega}{18\,k\Omega + 36\,k\Omega} = \frac{648\ M}{54\ K}\ 10^3 = 12\,k\Omega$$

$$i_e = i_B + \beta i_B$$

$$= i_B(1 + \beta)$$

$$i_e = i_B(1 + 75) \rightarrow (1)$$

K.V.L for Loop1

$$V_{th} - 0.7 = i_B(12k\Omega) + i_B(1+75)R_E$$

$$\therefore i_B = \frac{V_{th} - 0.7}{12K + 76 * 16k\Omega} = \frac{3.3}{1228} = 2.6\ \mu A.$$

K.V.L for Loop2

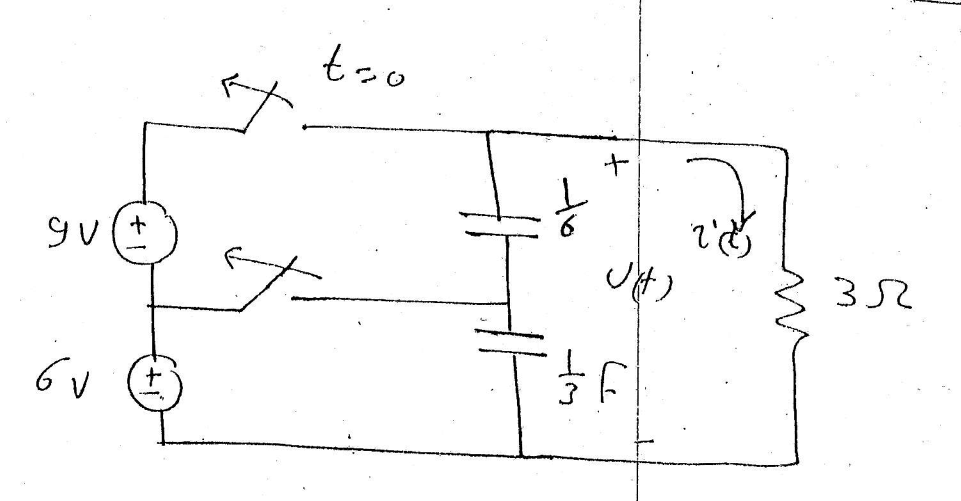
$$V_{CC} = \beta i_B(R_C) + V_{CE} + i_e R_E \quad (i_e = (1+\beta)i_B)$$

$$\therefore V_{CE} = V_{CC} - i_B(\beta R_C + (1+\beta)R_E)$$

$$= 12 - 2.6\mu A(75 * 22 * 10^3 + 76 * 16 * 10^3)$$

$$= 4.5\ V$$

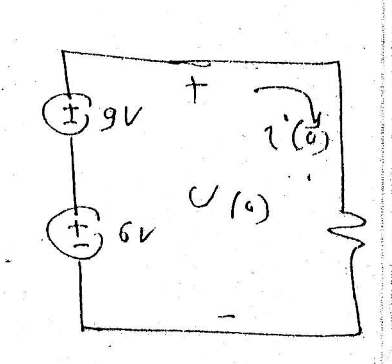
4 if the switch is opened at $t = 0$ find the variables $i(t)$ and $v(t)$ what is the total energy stored in the circuit at $t = 0$.



$t < 0$

$$v(0) = 9 + 6 = 15\ V$$

$$i(0) = \frac{15}{3}$$



$t > 0$

$v(t)$

$$C_{eq} = \frac{\frac{1}{6} * \frac{1}{3}}{\frac{1}{6} + \frac{1}{3}} = \frac{1}{9}\ F$$

C_{eq}

$\frac{C_1 * C_2}{C_1 + C_2}$

K.C.L at $v(t)$.

$$0 = \frac{v(t)}{3} + \frac{1}{9}\frac{dv(t)}{dt}$$

$$0 = 3\,v(t) + \frac{dv(t)}{dt} \longrightarrow v_c(t) = K e^{-3t}$$

$$v_p(t) = 0$$

$v(0) = 15 = K \rightarrow K = 15$

$\therefore v(t) = 15\, e^{-3t}$

$i(t) = \frac{v(t)}{3} = \frac{15}{3} e^{-3t} = 5\, e^{-3t}$.

---

[5] The circuit in fig is connected to a 220 V., 50Hz, AC, supply. Find, The current, the power, the power factor the reactive volt. amp. and the voltage drop across each element. Draw the phasor diagram.

8Ω 63.7 mH

220/50Hz 227 Mf

Solution:

$Z = R + X_L + X_C$

$= R + jWL \frac{-j}{WC}$

$= 8 + j20 - j14$

$= 8 + j6$

$Z = 10 \angle 36.86$

$X_L = jWL$

$= j * 2\pi * 50 * 63.7mH$

$= j20$

$X_C = \frac{-j}{2\pi * 50 * 227 * 10^{-6}}$

$= -j14$

$$I = \frac{V}{Z} = \frac{220 \angle 0}{10 \angle 36.86} = 22 \angle -36.86^\circ$$

$$S = V.I^*$$

$$= 220 * 22 \angle 36.86$$

$$= 4840 \angle 36.86$$

$$S = 3872 + j\,2903.3$$

$$P.f = \cos\theta_Z = \cos 36.86 = 0.8$$

Reactive Volt. Amp = 2903.3

$$V_R = I * R = 22 \angle -36.86 * 8$$

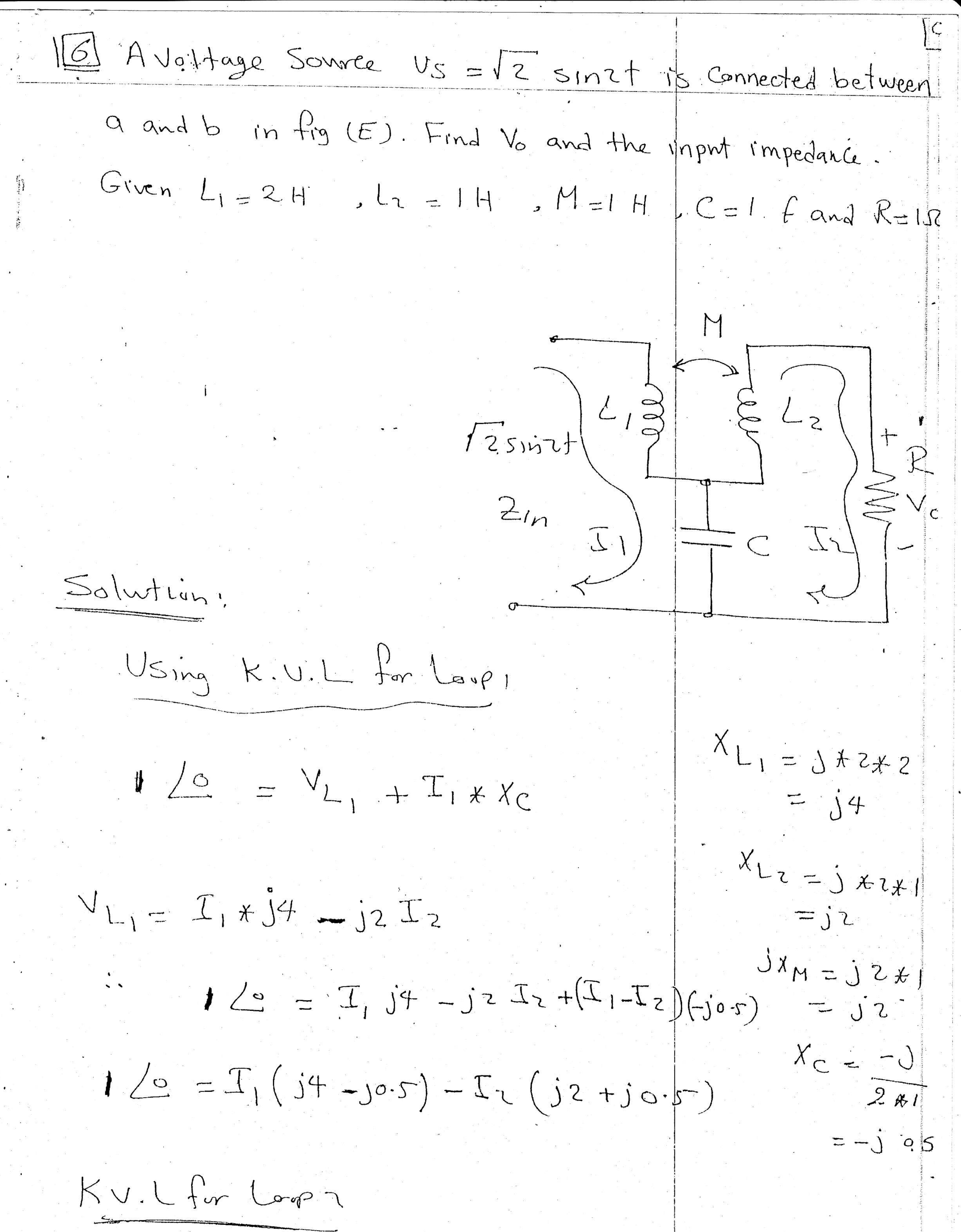
$$= 176 \angle -36.86$$

$$V_L = I * X_L = 22 \angle -36.86 * 20 \angle 90^\circ$$

$$V_L = 440 \angle 53.14^\circ$$

$$V_C = I * X_C = 22 \angle -36.86 * 14 \angle -90^\circ$$

$$V_C = 308 \angle -126.86^\circ$$



[16] A Voltage Source $V_S = \sqrt{2}\sin 2t$ is Connected between a and b in fig (E). Find V_o and the input impedance. Given $L_1 = 2H$, $L_2 = 1H$, $M = 1H$, $C = 1 f$ and $R = 1\Omega$

Solution:

Using K.V.L for Loop 1

$$1\angle 0 = V_{L_1} + I_1 * X_C$$

$$X_{L_1} = j*2*2 = j4$$

$$X_{L_2} = j*2*1 = j2$$

$$V_{L_1} = I_1 * j4 - j2\, I_2$$

$$jX_M = j2*1 = j2$$

$$\therefore\ 1\angle 0 = I_1\, j4 - j2\, I_2 + (I_1 - I_2)(-j0.5)$$

$$X_C = \frac{-j}{2*1} = -j\,0.5$$

$$1\angle 0 = I_1(j4 - j0.5) - I_2(j2 + j0.5)$$

KV.L for Loop 2

$$0 = (I_2 - I_1)(-j0.5) + V_{L_2} + I_2 * 1$$

$V_{L_2} = I_2 (j2) - j2 I_1$

$\therefore \quad 0 = (I_2 - I_1)(-0.5j) + I_2 (j2) - j2 I_1 + I_2$

$0 = -1.5j I_1 + (1 + 1.5j) I_2$

بحل المعادلتين نوجد I_1 , I_2

$V_o = I_2 * R$

$= I_2 * 1$

$$\begin{bmatrix} 1\angle 0 \\ 0 \end{bmatrix} = \begin{bmatrix} j3.5 & -j1.5 \\ -1.5j & 1+1.5j \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

$$I_1 = \frac{\Delta 1}{\Delta} = \frac{\begin{vmatrix} 1\angle 0 & -j1.5 \\ 0 & 1+1.5j \end{vmatrix}}{\begin{vmatrix} j3.5 & -j1.5 \\ -1.5j & 1+1.5j \end{vmatrix}}$$

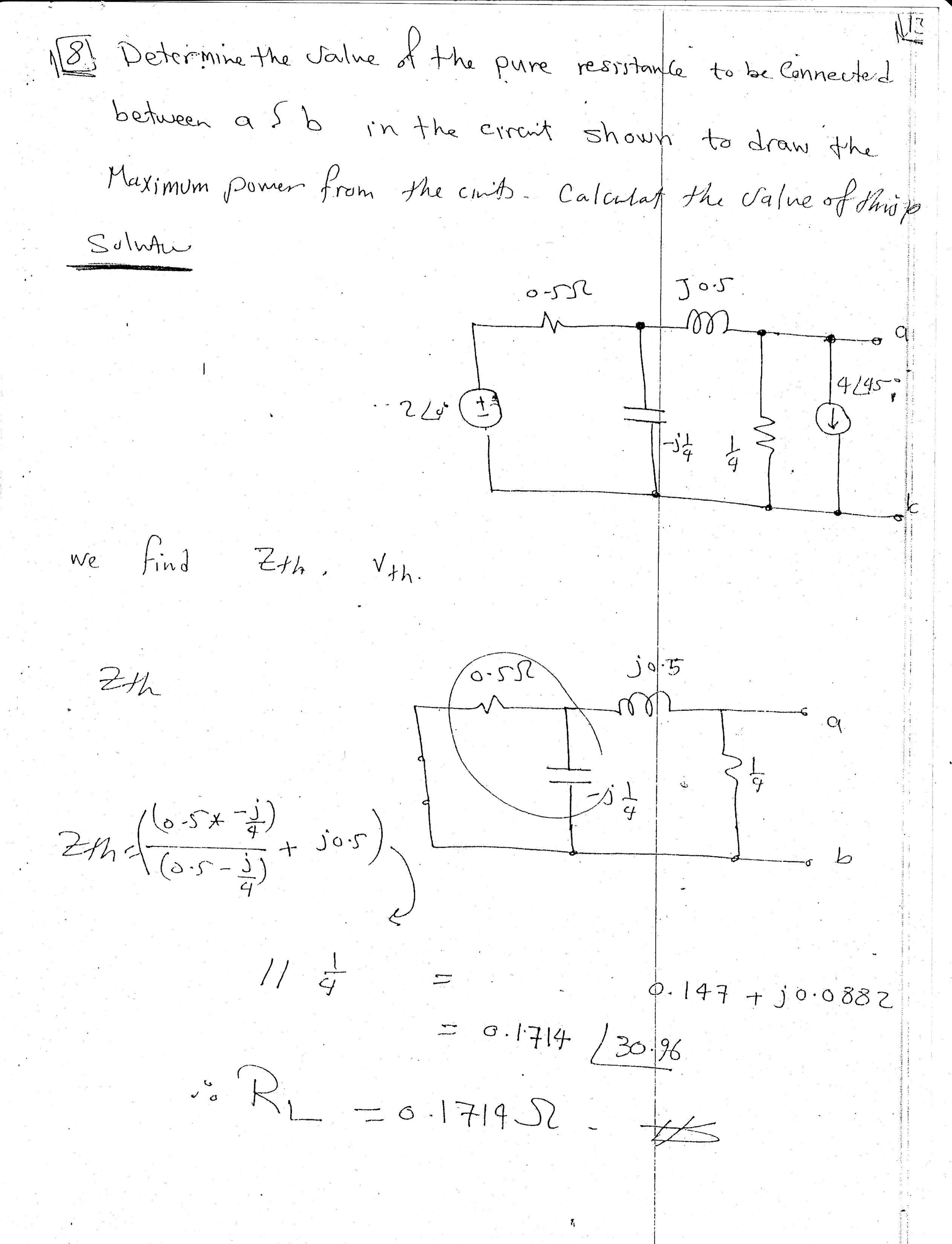
$$I_2 = \frac{\Delta 2}{\Delta} = \frac{\begin{vmatrix} -j3.5 & 1\angle 0 \\ -1.5j & 0 \end{vmatrix}}{\begin{vmatrix} j3.5 & -j1.5 \\ -1.5j & 1+1.5j \end{vmatrix}}$$

$$Z_{in} = \frac{\Delta}{\Delta_{11}} = \frac{\begin{vmatrix} -j3.5 & -j1.5 \\ -1.5j & 1+1.5j \end{vmatrix}}{1 + 1.5j}$$

7

متروك

للطالب



8) Determine the value of the pure resistance to be connected between a & b in the circuit shown to draw the maximum power from the ckts. Calculate the value of this p

Solution

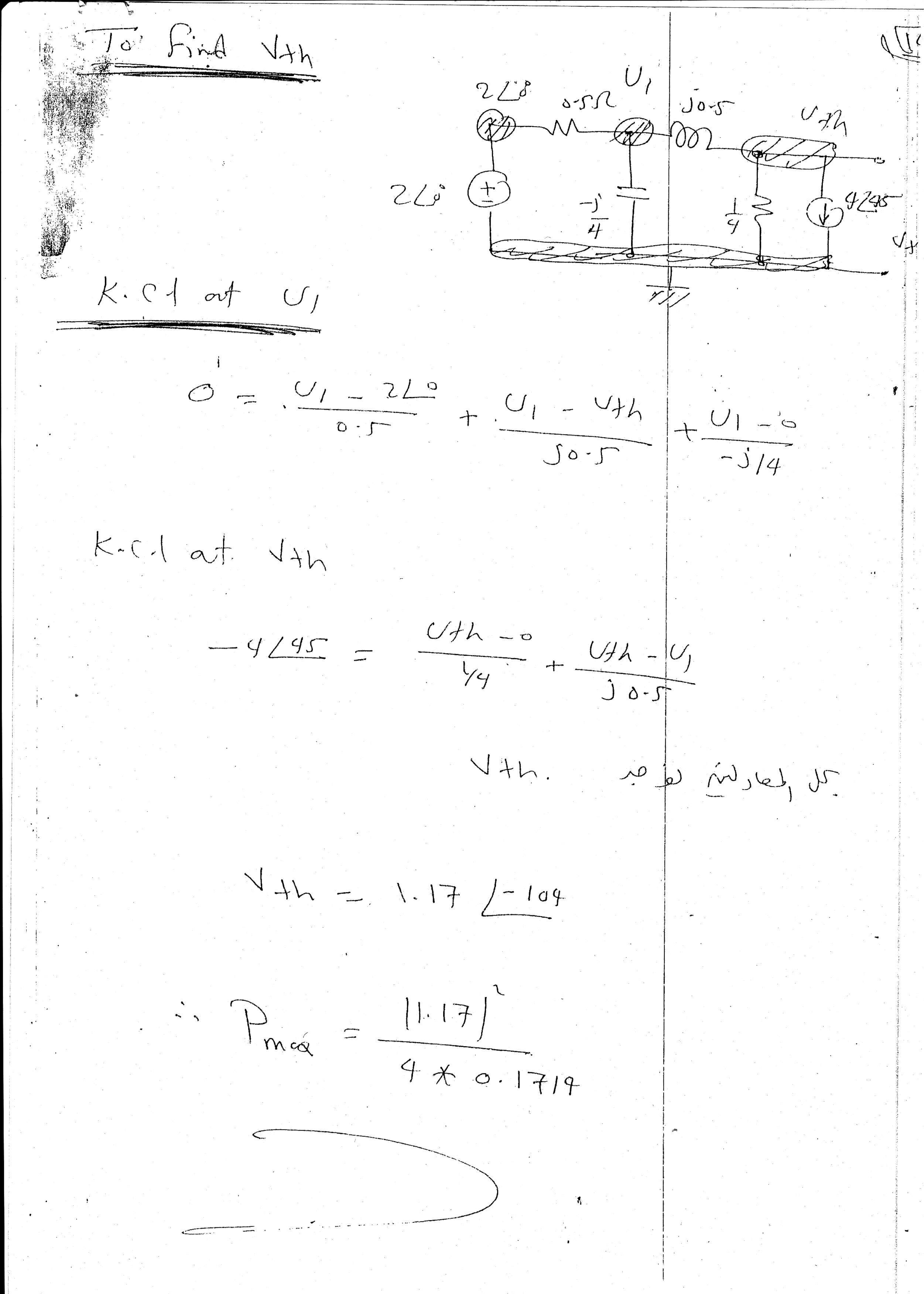
We find Z_{th}, V_{th}.

Z_{th}

$$Z_{th} = \left(\frac{(0.5 \times -\frac{j}{4})}{(0.5 - \frac{j}{4})} + j0.5 \right) // \frac{1}{4} = 0.147 + j0.0882$$

$$= 0.1714 \angle 30.96$$

$\therefore R_L = 0.1714\ \Omega$ #



To find V_{th}

K.C.L at V_1

$$0 = \frac{V_1 - 2\angle 0}{0.5} + \frac{V_1 - V_{th}}{j0.5} + \frac{V_1 - 0}{-j/4}$$

K.C.L at V_{th}

$$-4\angle 45 = \frac{V_{th} - 0}{1/4} + \frac{V_{th} - V_1}{j0.5}$$

بحل المعادلتين نوجد V_{th}.

$$V_{th} = 1.17 \angle -104$$

$$\therefore P_{max} = \frac{|1.17|^2}{4 * 0.1719}$$

متروك

للطالب